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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Paper No. 18

Application Number: 08/845,526
Filing Date: April 25, 1997
Appellant(s): PAPAKIPOS ET AL.

Glenn D. Barnes
For Appellant

EXAMINER'S ANSWER

This is in response to appellant's brief on appeal filed 8/10/2001.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The brief does not contain a statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief. Therefore, it is presumed that there are none. The Board, however, may exercise its discretion to require an explicit statement as to the existence of any related appeals and interferences.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is substantially correct. The changes are as follows:

Issue 2: Whether Claims 9 and 12 are unpatentable under 35 U.S.C. 103(a) over Luken, Jr. U.S. Patent No. 5,278,948 in view of Jia et al U.S. Patent No. 5,726,896 and further in view of Schulmeiss U.S. Patent No.5,717,847 and Sherman U.S. Patent No. 5,734,756.

Issue 3: Whether Claims 16, 18, and 19 are unpatentable under 35 U.S.C. 103(a) over Luken, Jr. U.S. Patent No. 5,278,948 in view of Jia et al U.S. Patent No. 5,726,896 and further in view of Schulmeiss U.S. Patent No.5,717,847.

(7) Grouping of Claims

Appellant's brief includes a statement that claims grouped as per the grounds of rejection which Appellants contest, and which are separately identified and argues in the Appeal Brief, do not stand or fall together and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

5,726,896	Jia et al	3-1998
5,278,948	Luken, Jr.	1-1994
5,717,847	Schulmeiss	2-1998
5,488,684	Gharachorloo	1/1996
5,734,756	Sherman et al	3-1998
5,202,670	Oha	4-1993

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-25 rejected under 35 U.S.C. 103(a). This rejection is set forth in prior Office Action, Paper No. 13, and is repeated here for reference.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claims 1-2, 6, 8, 13, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent Number 5,717,847).

In claim 1, the applicant lays claim to a computer system that implements the method of receiving a NURBS model from a server, converting it to a Bezier model, generate a plurality of control points on the Bezier curve from a plurality of NURBS control points using a tri-linear interpolator in the graphics pipeline, using NURBS control points as input to the tri-linear interpolator, and evaluating these points to generate Bezier control points and rendering the curve using the graphics pipeline, **without first converting the NURBS defined curve or surface to a polygon mesh.**

Jia et al teach a method of converting a NURBS surface model to a Bezier surface model, evaluating a plurality of NURBS control points into Bezier control points (Col.3: lines 32-37, Col. 4: lines 38-45), and interpolating a plurality of control points

(Col. 5: lines 1-5). **Jia also teaches generating a curve without first converting the NURBS defined curve to a polygon mesh (Fig.5).** *Jia et al* fail to teach the use of tri-linear interpolator, and a method to receive the data from the server (host processor) and rendering it. *Gharachorloo et al* teach a method to receive data from a host processor into a graphics pipeline, and use the graphics pipeline to render the object (refer Figs. 1, 2, 2A). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it would be obvious to one skilled in the art at the time the invention was made to store the surface model data in a host processor, and use this method to download the data as needed, and use a tri-linear interpolator to generate the Bezier control points from NURBS control points as this would ensure better utilization of system processing resources on the client, and provide high speed and accuracy and enable velocity control to a given tolerance.

Claim 2 adds to claim 1 the step of receiving the NURBS surface model via the bus.

Gharachorloo et al teach a method to receive data using a bus (refer Fig. 1). Hence it would be obvious to one skilled in the art at the time the invention was made to use a bus to receive the NURBS model from a host processor, as it is an effective and dependable communication medium.

Claim 6 adds to claim 1 the limitation of generating points on the curve using Bezier control points.

Jia et al disclose the use of Bezier control points as input to the processor that determines points on the curve (Col.3: lines 32-44).

Claim 8 adds to claim 1 the use of graphics rendering pipeline to render the curve or surface.

Gharachorloo teaches the use of a Graphics pipeline (Fig. 1). Hence it would be obvious to one skilled in the art at the time the invention was made to use a graphics pipeline to render the curve as this would streamline the process, and accelerate the process of rendering the curve.

Claim 13 lays claim to a graphics rendering pipeline of a computer system that evaluates the NURBS control points to a Bezier model using a tri-linear interpolator in the graphics pipeline, generates a plurality of control points on the Bezier curve, and renders the curve.

Jia et al teach a method of loading a processor with the NURBS control points (Col.3: lines 32-36), converting the NURBS surface model to a Bezier surface model (Col. 4: lines 38-48), and determining a plurality of points on the Bezier curve. *Jia et al* fail to teach a method of rendering the curve using a graphics pipeline. *Gharachorloo et al* teach a method of using the graphics pipeline to render NURBS surfaces (Col.9: lines

64-67). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it would be obvious to one skilled in the art at the time the invention was made to use a graphics pipeline to render the Bezier curve using the points derived by using the method as described by Jia, as this would streamline the rendering process, and ensure better utilization of system processing resources, and provide better control over velocity levels.

Claim 14 adds to claim 13 the limitation of using a tri-linear interpolator to evaluate the NURBS control points into Bezier control points.

Jia teaches the method of evaluating a plurality of NURBS control points into Bezier control points. Jia fails to teach the use of tri-linear interpolator, and the input of NURBS control points to the tri-linear interpolator. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Hence it is obvious to one skilled in the art at the time the

invention was made to use a tri-linear interpolator to generate the Bezier control points since this will provide high speed and accuracy.

Claim 15 adds to claim 13 the step of transforming the NURBS curve or surface from a global domain to a local domain.

Gharachorloo teaches a method of transforming the NURBS surface model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27). Hence it is obvious to one skilled in the art at the time the invention was made to use global to local transformation of the NURBS curve, as such a transformation can make better utilization of the available resources.

6. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent Number 5,717,847) as applied to claim 6, and further in view of Sherman et al. (U.S. Patent 5,734,756).

Claim 7 adds to claim 6 the limitation that the Bezier control points are input to a tri-linear interpolator to generate points on the curve.

Jia et al disclose the use of Bezier control points as input to the processor that determines points on the curve (Col.3: lines 32-44). Jia et al also teach that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Jia et al fail to disclose the use of tri-linear interpolator. Luken inherently teaches the use of tri-linear interpolators

by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Sherman et al teach that Bezier curves are generally evaluated using a recursive algorithm due to de Casteljau (Col.14: lines 32-35). Since Bezier curve is a special case of a NURBS curve, it would be obvious to one skilled in the art at the time the invention was made to input the Bezier control points to a tri-linear interpolator to generate points on the curve, as this would improve system performance.

7. Claims 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Luken, Jr.* (U.S. Patent Number 5,278,948), *in view of Jia et al.* (U.S. Patent Number 5,726,896), *Sherman et al* (U.S. Patent Number 5,734,756), and Schulmeiss (U.S. Patent Number 5,717,847).

Claim 9 lays claim to a method of rendering curves by evaluating a Bezier curve using de Casteljau process using a tri-linear interpolator in the graphics rendering pipeline, without first converting the NURBS defined curve or surface to a polygon mesh.

Luken teaches the use of Cox-DeBoor (or DeCasteljau) process for evaluating a b-spline curve (Col.15: lines 40-44). Luken also teaches the method of using a graphics pipeline (Col.28: lines 59-61), and the use of Cox-DeBoor process in the graphics processor for evaluation (Col.29: lines 5-10). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear

interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken fails to teach the use of these methods for a Bezier curve. Jia et al also teach that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Sherman discloses that the de Casteljau process is a widely accepted method of evaluating Bezier curves (Col. 14: lines 32-35). **Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Jia also teaches generating a curve without first converting the NURBS defined curve to a polygon mesh (Fig.5).** Hence it would be obvious to one skilled in the art at the time the invention was made to use the de Casteljau process, and a tri-linear interpolator in the graphics pipeline to evaluate and render a Bezier curve, since this would render the system faster.

4. Claims 16, 18, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,278,948) as applied to claim 16, in view of *Jia et al.* (U.S. Patent Number 5,726,896) and Schulmeiss (U.S. Patent Number 5,717,847).

Claim 16 lays claim to a method of generating normal vectors for a surface based on generating surface partials using a tri-linear interpolator loaded with Bezier control points as input, then generating surface tangents from these partials, and generating normals from these tangents.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of

the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken also teaches the use of interpolators for each component to derive the surface partials (Col. 19: lines 18-25). Luken fails to teach the use of Bezier control points as input to the tri-linear interpolator. Jia teaches the method of evaluating Bezier control points (line 35-40). Jia also teaches that Bezier curve is a special case of a B-spline curve. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it is obvious to one skilled in the art at the time the invention was made to use Bezier control points as input to a tri-linear interpolator to generate surface partials, since Bezier points are a subset of NURBS control points.

Claim 18 adds to claim 16 the step of generating the surface tangents from the surface partials using a blender in the graphics pipeline.

Luken teaches the generation of surface tangents from surface partials for NURBS surfaces (Col.9: lines 6-25). Luken fails to teach this for blending curves. Jia teaches that the Bezier curves are a special case of B-splines, and also teaches the use of Bezier curves as blending functions (Col. 7: lines 29-31). Hence it is obvious to one skilled in the art at the time the invention was made to use such blending curves, since the shape approximation with NURBS is not generally understood, and the NURBS can be exactly represented by a series of piecewise Bezier curves.

Claim 19 adds to claim 18 the step of generating at least one normal from the surface tangents.

Luken teaches the method of generating normals from surface tangents ((Col.9: lines 6-25).

8. Claims 20-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684).

Claim 20 lays claim to a method of rendering a curve by doing a global to local transformation, evaluating the NURBS control points using tri-linear interpolation, and rendering the curve using the points thus created.

Luken teaches a method of evaluating NURBS control points to derive points on the curve (Col.15: lines 40-45). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken fails to teach a transformation from global domain to local domain. Gharachorloo teaches a method of transforming the NURBS surface model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27), rendering a NURBS curve. Hence it would be obvious to one skilled in the art at the time the invention was made to use the transformation as taught by Gharachorloo so as to make better utilization of the local resources.

Claim 21 adds to claim 20 the step of indexing at least one look up table for performing the transformation.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics control processor (Col.12: lines 18-20).

Claim 22 adds to claim 21 the limitation of evaluating the NURBS control points using tri-linear interpolator.

Luken inherently teaches the use of tri-linear interpolators for evaluating the NURBS control points, by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45).

Claim 23 adds to claim 22 the limitation of indexing the look up table to be able to configure the tri-linear interpolator.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics control processor (Col.12: lines 15-20), which is used to transform the x, y, z coordinates of the control points.

Claim 24 adds to claim 23 the step of implementing a quadri-linear interpolator using tri-linear interpolator, and generating control points.

Luken discloses the existence of NURBS control points with coordinates (wx,wy,wz,w), and the evaluation of such control points by interpolation (Col.15: lines 32-46). This inherently teaches quadri-linear interpolation.

9. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), and further in view of Oha (U.S. Patent Number 5,202,670).

Claim 25 adds to claim 20 the use of convolution in the graphics pipeline to obtain points on the curve.

Oha teaches the convolution of original data and interpolated function in the graphics pipeline to derive a set of points on the curve (Col.15: lines 5-13). Hence it is obvious to one skilled in the art at the time the invention was made to use convolution in order to achieve faster processing of the control points.

(11) Response to Argument

Addressing the arguments against the combination of references in the rejection of claim 20 first, that being the broadest claim, it is noted that Luken teaches a graphics pipeline (Fig.2) to render a parametric surface, and also teaches pipeline to decompose NURBS to Bezier (Col.1 45-50). Bezier curves define parametric surfaces. Thus, both Luken and Gharachorloo disclose methods for rendering parametric surfaces, and hence may be combined for better resource utilization. Claim 1 has the added limitation over claim 20, of converting NURBS control points to Bezier control points, without first

converting the NURBS defined curve or surface to a polygon mesh. This is taught by Jia, as explained in the rejection to claim 1. Applicants argue that Jia is concerned with spline interpolation for the control of numerically controlled machines. It is being reiterated that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). Jia teaches the art of converting an inputted NURBS surface model to a Bezier surface model, evaluating a plurality of NURBS control points into Bezier control points (Col.3: lines 32-37, Col. 4: lines 38-45), and interpolating a plurality of control points (Col. 5: lines 1-5). While Jia uses the Bezier surface model in the control of a CNC machine, to control the machine tool to a defined path, there is nothing in Jia that precludes one from displaying the curve or surface thus generated, and using Jia's teaching in other applicable situations. Moreover, Luken teaches de casteljau algorithm to perform trilinear interpolation for the NURBS control points, and Schulmeiss teaches de casteljau algorithm to evaluate bezier control points. Since Jia teaches converting NURBS control points to Bezier control points, one could use the teaching of Luken to interpolate NURBS control points, and evaluate these to generate bezier control points as taught by Schulmeiss.

As to applicant's argument that Jia describes Fig.5 as showing the cubic curve in Fig.2, by its Bezier control polygons, it is noted that Jia teaches that the "coefficients of

the control polygons define five different Bezier curves", and hence do not constitute a polygon mesh for the inputted NURBS model.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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